ForCES Protocol TML Over IP Networks

<draft-wang-forces-iptml-00.txt>

Weiming Wang, Ligang Dong

(wmwang, donglg) @mail.zjgsu.edu.cn

Nov 8, 2005

浙江工商大学
Zhejiang Gongshang University

Two motivations that drive this TML

- A TML that adopts TCP+UDP
- A TML that does not have to take TML level messages
  - TML level messages were thought to be used for TML multicast setup purposes.
  - Whereas the conclusion the messages are not very necessary

Transport Scheme

- TCP + UDP
  - TCP for PL control msg
  - UDP for redirect and HB msgs
  - Form a TCP-UDP Pair
    - whenever a TCP connection for the TML is established, by default, a UDP connection with the same source and destination should also be established for this TML.
  - Reason to be paired
    - ease the connection establishment process.
    - To control UDP stream with the reference to the TCP stream CC status(See latter)
  - An IP TML should at least establish one TCP-UDP pair connection
  - An IP TML may also supply more than one TCP-UDP pair connections (need more evaluation on the necessity)
    - may be applied for multi-priority cases

TCP for

- PL control messages that require strict reliability, in the form of:
  - unicast
  - multiple unicast for PL multicast

UDP for

- PL redirect messages
  - unicast and mulitcast(rather than multiple UDP unicasts)
- PL heartbeats
  - unicast and mulitcast

Benefits from UDP

- Well-known and widely available
- The generic feature for raw data transmission that minimizes the side effects on protocols shipped over it:
  - avoided TCP over TCP
  - avoided any kind of CC over CC
- Efficient for redirect and heartbeat message multicast
  - multicast for CE->FE redirect is a very common case, e.g.:
    - for routing protocol messages
    - for multicast protocol messages
  - And just consider hundrds of FEs connected to a CE

Problem with UDP

- UDP is More aggressive than TCP, which leads to:
  - unfair bandwidth allocation when TCP and UDP are in the same link, which leads to TCP congestion collapse
  - In the ForCES case, this will leave space for DoS attack from redirect messages.

Possible Solutions to the UDP DoS Attack

- Goal
  - to suppress UDP stream in some way that the UDP will not block TCP control message transmission
  - This implies we don't need a very strict and full congestion control for the UDP stream
- A full solution may need two levels of work:
  - PL and FE model level
  - TML level

DoS Prevention - PL and FE Model Level

- Possible Steps
  - FE TML notifies FE PL and CE PL of its congestion status and DoS attack alert events
  - CE modifies the FE LFB to limit the redirect flow in some way to suppress the redirect stream
- Problem
  - a minimum bandwidth for control message transmission between FE TML and CE TML must be guaranteed,
  - or else, above steps cannot go

DoS Prevention - TML Level (1)

- The main goal is to guarantee a minimum bandwidth for control messages that is over TCP channel.
- An idea we now take:
  - in a TCP-UDP pair, we try to control UDP stream with reference to TCP stream regarding its congestion status.
  - in another word, to roughly bind UDP to TCP on the congestion control (no need for accurate one)
  - the simplest algorithm to do so:
    - TCP packets go as there were only TCP channel
    - UDP packets are put in transport layer below for transmission only if:
      - TCP channel is free
      - or, TCP channel is not free, but at least one TCP packet is transmitted since UDP channel has sent a packet last time.
    - Above algorithm is done by an component called Arbiter in the IP TML.

DoS Prevention - TML Level (2)

- Experiment results:
  - Link=10M(single hop, single CE-FE), TCP=5M(constant), UDP changes from 1M to 20M, to observe the throughput changes of UDP and TCP

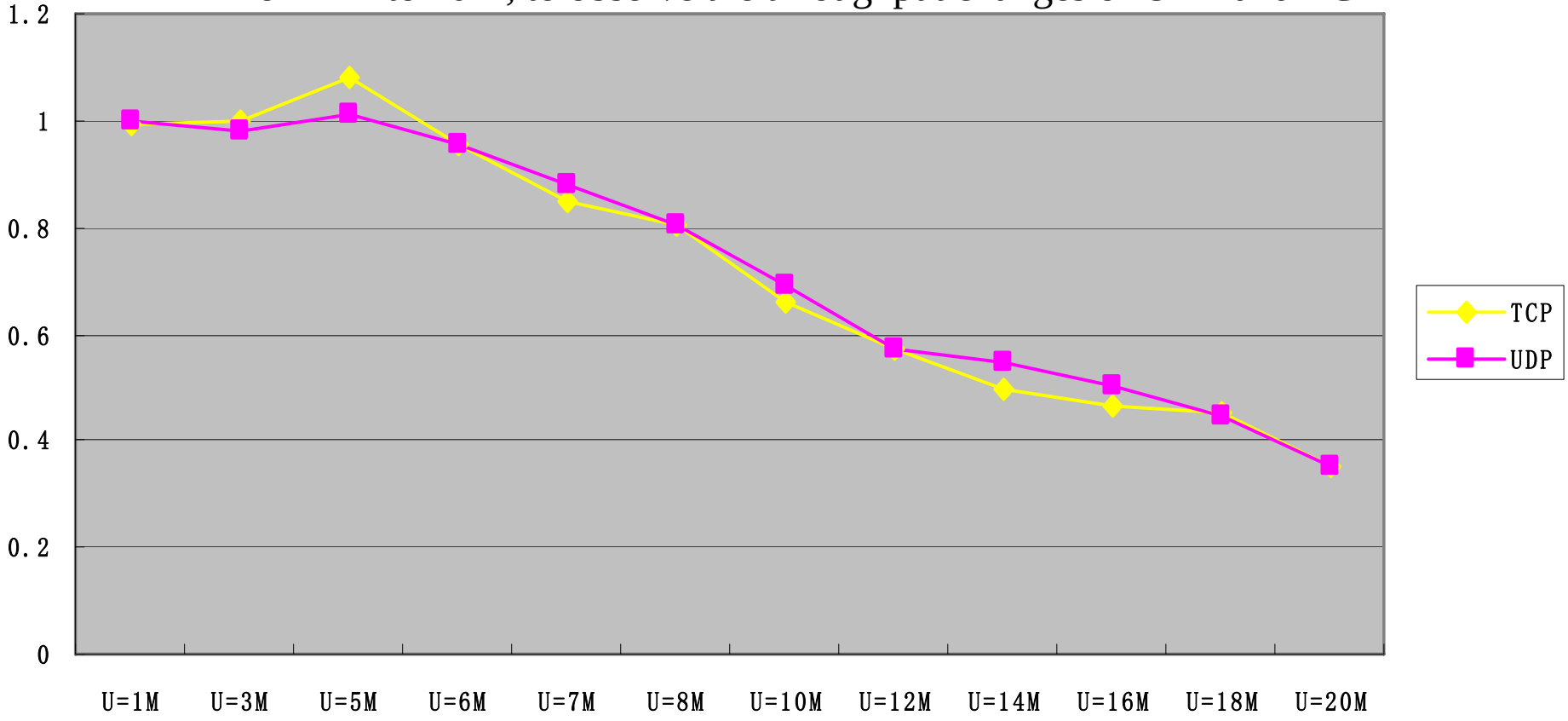
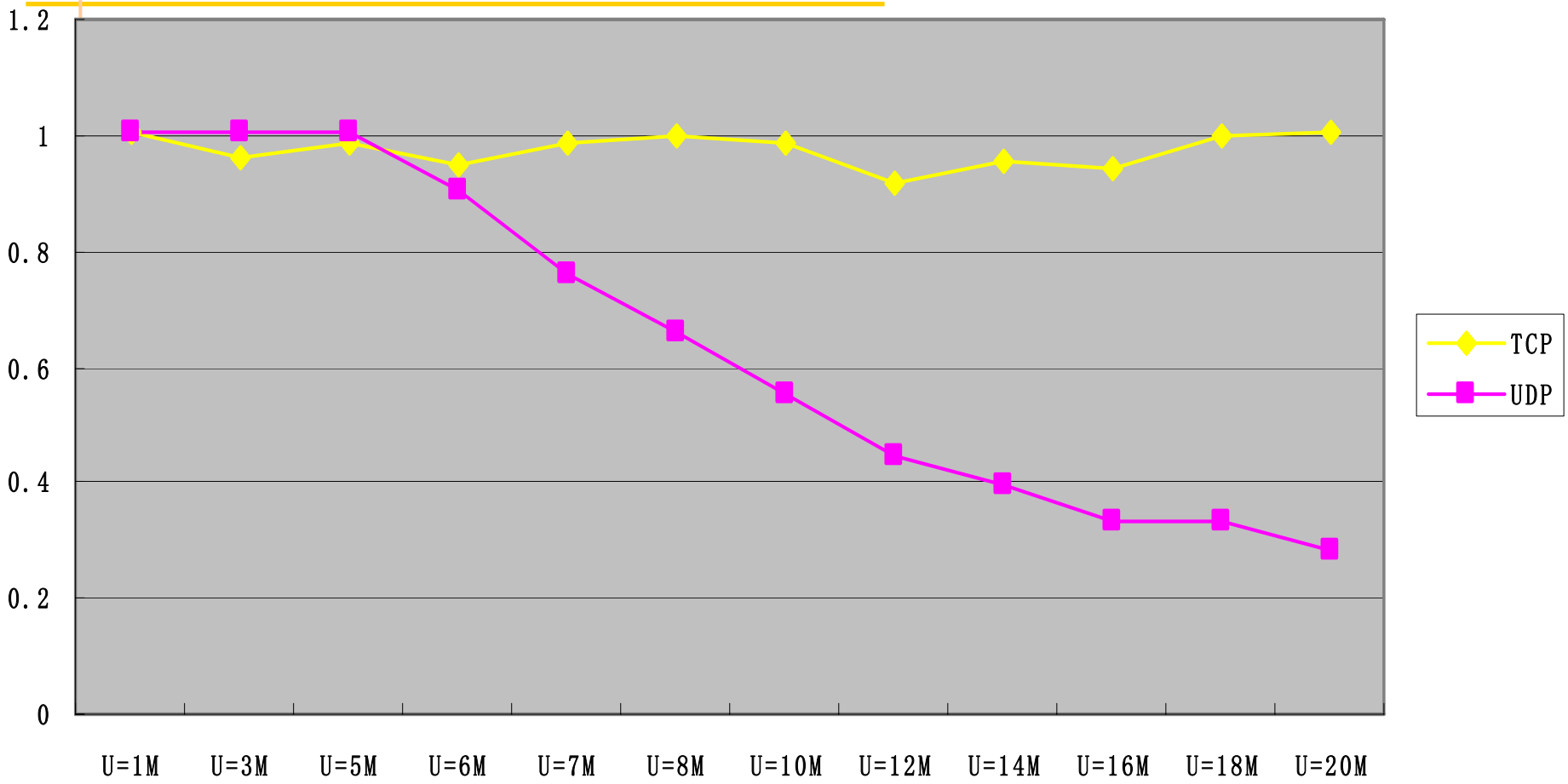


Fig 1. UDP are independent of TCP

浙江工商大学 Zhejiang Gongshang University

DoS Prevention - TML Level (3)



- The UDP relative throughput decrease, but the absolute throughput keeps around 5M, the same as TCP(5M)

Fig 2. UDP binding to TCP

浙江工商大学 Zhejiang Gongshang University

TCP+UDP
Comments and Conclusions

- Comments
  - It is possible to make a way out to prevent the ForCES TCP from being congested by its own UDP.
  - It may not be possible to make a way to prevent ForCES TCP from being congested by other UDPs in a public network.
    - i.e., whatever scheme or protocols we take for redirect data transmission, the TCP will always be in danger of being congested in a public network.
  - This actually implies: to find a CCed protocol for redirect transmission might be actually at the same problem solving level as to adopt UDP and find a way to prevent the UDP from blocking its own TCP.
- Conclusion: we may have other schemes also, but UDP should be one of the choices for ForCES

TML Multicast

- Control msgs (other than HB msg) multicast should take multiple TCP unicasts.
- Redirect msg and HB msg multicast should directly take UDP multicast.

TML Multicast Setup

- Four cases
  - Case1: CE->FEs UDP multicast
  - Case2: CE->FEs multiple TCP unicasts
  - Case3: FE->CEs UDP multicast
  - Case4: FE->CEs multiple TCP unicasts

Case 1: CE to FEs UDP multicast

- Setup Steps:
  1. CE configures a Multicast List to CE-TML and FE-TMLs
     1. CE forms a multicast list with groupID and FE memberIDs
     2. CE sends the list to the CE TML by TMLconfig SP
     3. CE sends the list to individual FEs by CE PL Configure messages
        - actually to configure the attributes of FE protocol LFBs
     4. FEs sends the list to their TMLs by means of TMLconfig SP.
  2. CE configures the group IP address of the UDP multicast to the CE-TML and the FE-TMLs. This is expressed as a TML attribute (a TML multicast specific parameter).
     - With the same steps as 1 to 4
  3. TML runs IP multicast control protocol like IGMP for the TML to join or leave the multicast group.
  4. CE-PL sends PL multicast msg using the group ID, while CE-TML map the group ID to the group IP address and send it in a multicast way. FE-TMLs who joined in the group can then reveive it.

– no need for TML level messages

Case 2: CE to FEs multiple TCP unicast

- Setup Steps:
  1. CE configures a Multicast List to CE-TML and FE-TMLs
     - the same as Case 1
  2. CE does not have to configure other parameters for the multicast.
  3. TML does not have to run other multicast control protocols for the TML to join or leave the multicast group.
  4. CE-PL sends PL multicast msg using the group ID, while CE-TML map the group ID to the IP addresses of FEs in the memberlist, and then send it in a TCP unicast way. All FE-TMLs who have been included in the multicast list will receive this PL msg.

– no need for TML messages

Case 3: FE->CEs UDP multicast

- Setup Steps:
  1. Master CE configures a Multicast List to CE-TMLs and FE-TML
     1. Master CE forms a multicast list with groupID and CE memberIDs
     2. Master CE sends the list to the FE doing the multicast by CE PL Configure messages
        - actually to configure the attributes of FE protocol LFBs
     3. Master CE sends the list to the CE TML by TMLconfig SP
     4. Master CE sends the list to alternative CEs by means of CE-CE management tools (out of scope)
  2. Master CE configures the group IP address of the UDP multicast to the CE-TML and the FE-TMLs with the same steps as 1 to 4.
  3. TML runs IP multicast control protocol like IGMP for the TML to join or leave the multicast group.
  4. FE-PL sends PL multicast msg using the group ID, while the FE-TML maps the group ID to the group IP address and send it in a multicast way. All CE-TMLs who joined in the group can then receive it.

– no need for TML messages

Case 4: FE to CEs multiple TCP unicast

- Setup Steps:
  1. Master CE configures a Multicast List to CE-TMLs and FE-TML
     - the same as Case 3
  2. CE does not have to configure other parameters for the multicast.
  3. TML does not have to run other multicast control protocols for the TML to join or leave the multicast group.
  4. FE-PL sends PL multicast msg using the group ID, while the FE-TML maps the group ID to the IP addresses of FEs in the memberlist, and then send it in a TCP unicast way. All CE-TMLs who have been included in the multicast list will receive this FE PL msg.

– no need for TML messages

Multicast Setup Conclusions:

- TML Multicast can be set at PL and TML SP level
- TML-TML level messaging is not very necessary for the setup process

Acknowledgement:

- Research is funded by:
  - NSF China (60273061, 60573116)
  - National Hi-Tech R&D Project (2005AA121310)
  - ZJ NSF (RC02063), ZJ Sci&Tec Project (2005C21013)

浙江工商大学
Zhejiang Gongshang University

Thank You!